

A map of Southeast Asia with several countries highlighted in red, including Thailand, Laos, Cambodia, Vietnam, Malaysia, and Indonesia. The map is overlaid with the title text.

Improved Outcomes for Out-of-Hospital Cardiac Arrest

A/Prof Marcus Ong Eng Hock

**Senior Consultant, Clinician Scientist and Director of Research
Dept of Emergency Medicine, Singapore General Hospital
Director, Health Services Research and Biostatistics Unit
Division of Research, SGH**

**Associate Director, Health Services and Systems Research (HSSR)
Duke-NUS Graduate Medical School**

Director, Unit for Prehospital Emergency Care (UPEC)

Senior Consultant, Ministry of Health, Hospital Services Division

What makes a good research question?



AT 22, S'PORE WOMAN SUFFERS CARDIAC ARREST AT HOME HER HEART STOPPED

31 TIMES

And she survives Page 2



PHOTOGRAPH BY MICHAEL YUNG
STYLING BY MICHAEL YUNG
HAIR BY MICHAEL YUNG
MAKEUP BY MICHAEL YUNG

She had cardiac arrest when she was

22 years old



PICTURES LIMKE WANGDAI

Her heart stopped 31 times even though she had no pre-existing health condition

REPORT: BENSON ANG
bang@hph.com.sg

AT 22, she suffered a cardiac arrest. And after the woman was sent to hospital, her heart stopped another 30 times. Thankfully, she survived.

Book editor Samantha Yong, now 23, suffered the cardiac arrest at home in the Toek Bangah area in January last year.

The Singaporean was getting ready for work that day when she suddenly fainted.

She told The New Paper yesterday: "I didn't really feel or remember anything about the incident."

A few days before the incident, Ms Yong had felt heart palpitations. But she didn't pay attention to it.

"I didn't have any pre-existing health conditions. So, it really came as a surprise when I fainted."

When she felt the symptoms, she checked her pulse, and she felt the same. She was shocked, but she didn't know what to do.

She called for an ambulance, but she didn't know what to say. She was so scared that she couldn't think straight.

only as Michael. The American, a computer programmer, now 25, saw Ms Yong lying unconscious on the floor. She looked pale and her lips were blue. But she had a pulse.

So Michael immediately called for an ambulance and conducted cardiopulmonary resuscitation (CPR) on her.

He had learnt this in high school, but had not performed it on anyone in about 10 years.

Said Ms Yong: "He was really scared and panicky. He had to talk himself through the steps to calm himself down."

'He really saved my life there'

"He really saved my life there. Without him, I won't be here."

The paramedics arrived, they gave her an electric shock, which restored her heartbeat to normal.

Ms Yong was sent to the accident and emergency department at Singapore General Hospital.

But there, her heart stopped another 30 times. Each time, she was revived with an electric shock.

She was eventually discharged from the hospital after 10 days.

She returned to work in March last year.

She said she was very grateful to Michael for saving her life.

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"My colleagues were the ones who arranged for an instructor to come in. I'm so touched by what they did."

— Ms Samantha Yong

have an automated implantable cardioverter defibrillator inserted into her chest.

This battery-powered device can monitor a patient's heart rhythm constantly.

When this rhythm is abnormal, the device administers electric shocks to correct the abnormalities.

Ms Yong was discharged 10 days after being admitted. She returned to work in March last year.

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World's first trial to boost heart attack survival rates

The Singapore General Hospital (SGH) will conduct the world's first trial to determine when is the best time to deliver electrical shocks to patients who suffer heart attacks.

SGH doctors will investigate if delivering this shock at a specific time during cardiopulmonary resuscitation (CPR) can improve the patients' chance of survival.

Cardiac arrest patients who are taken to its emergency department with severely abnormal heart rhythm are eligible for the study. They may be enrolled into it from next month.

Currently, patients who have cardiac arrests are given CPR and shocks to their hearts immediately.

The CPR is paused when the shock is delivered. But with the advent of automated CPR machines, pauses can be avoided and the shock can now be synchronised with CPR.

SGH's doctors hope this arrangement can increase shock success, as shown in animal studies.

The study aims to enrol 142 patients, to be randomly divided into two groups.

In each group, the automated CPR machine and defibrillator will be programmed to give a shock at a different time during the chest compression.

In one group, patients will be given the shock during a point when pressure is taken off the chest. In another,

patients will be shocked at the pre-compression phase, which is the current standard of care.

The pre-compression phase is the period between each complete chest compression.

The study is led by Associate Professor Marcus Ong, a senior consultant at SGH's department of emergency medicine. He said: "We want to increase patients' chances of survival. This study has the potential to significantly impact current practice of resuscitation."

Heart attacks are totally unpredictable and can strike anyone anywhere and at any time.

Cardiac arrests

According to a Straits Times report, more than 1,000 cardiac arrests happen in Singapore every year.

SGH alone sees 150 to 200 such patients each year. In Singapore, only 2 per cent of these patients survive. In the US, Europe and Japan, this figure is 20 per cent.

In general, conducting CPR immediately on a patient doubles his or her chances of survival.

SGH is organising a community forum this Saturday to inform the public about the study and teach them what to do if they encounter someone suffering a heart attack.

The free event, Surviving a Cardiac Arrest: What You Need to Know, will be held in the SGH at Block 6, Level 9, from 2pm to 4pm.

The forum will be conducted in English.



Nonetheless, the people around Ms Yong have taken precautions just in case the incident happens again.

Michael, now her husband, has installed several corner protectors around the house so she won't hurt herself if she falls again.

Her publishing company, World Scientific, also installed an automated external defibrillator (AED) in the office.

An AED is an external device which can help restore a normal heartbeat by delivering electric shocks.

Course in CPR

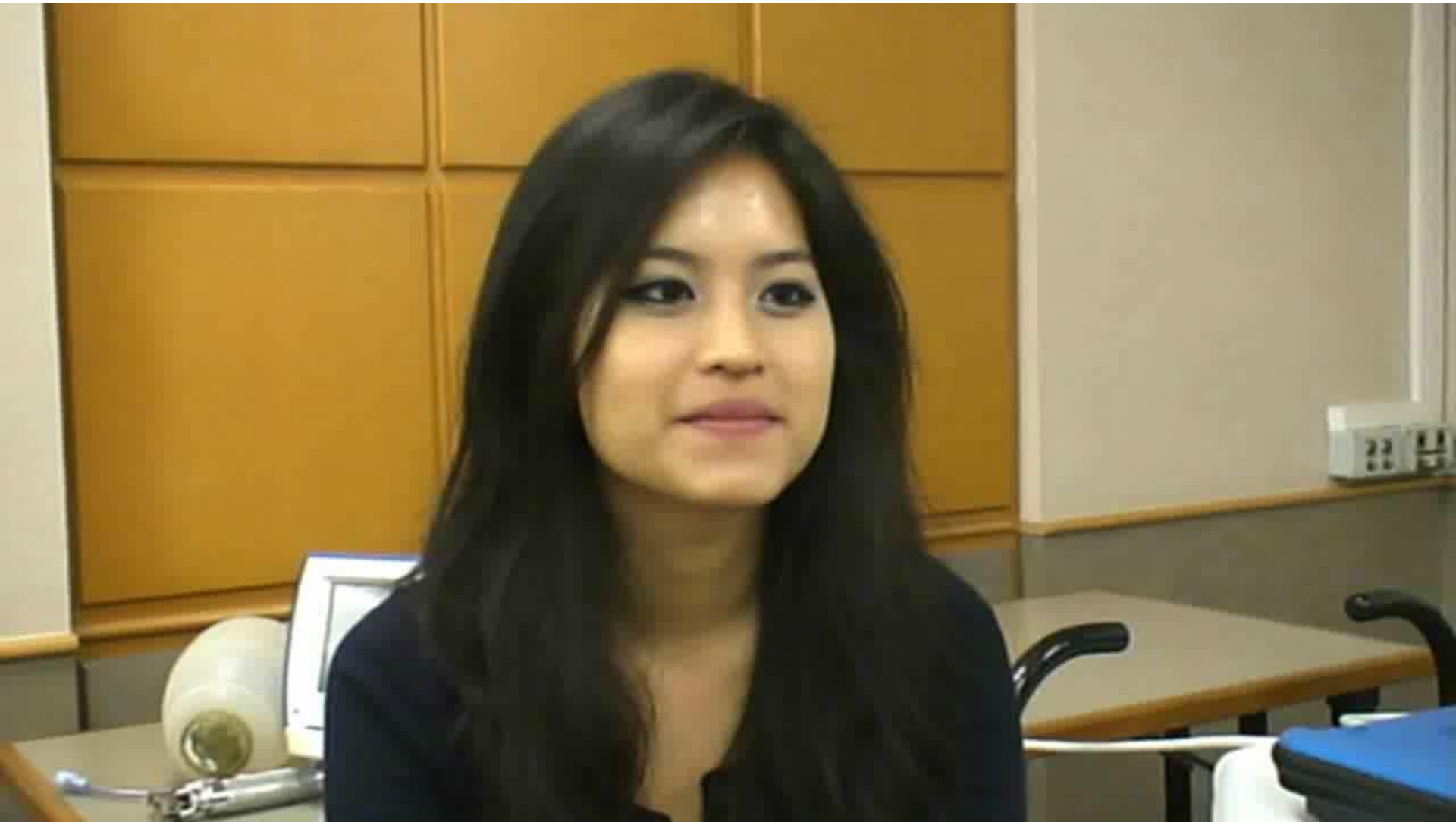
Ms Yong's colleagues had also volunteered to take a course in CPR last July.

She said: "During the episode, the heart is injured, unstable. It is not 'happy'. So it can stop again and again, even up to 20 times."

"It's like a storm that keeps coming. Thankfully, this happened in the hospital, where the doctors can revive the heart pretty quickly."

"If she was out of the hospital, she would probably have died."

It should be about improving outcomes!



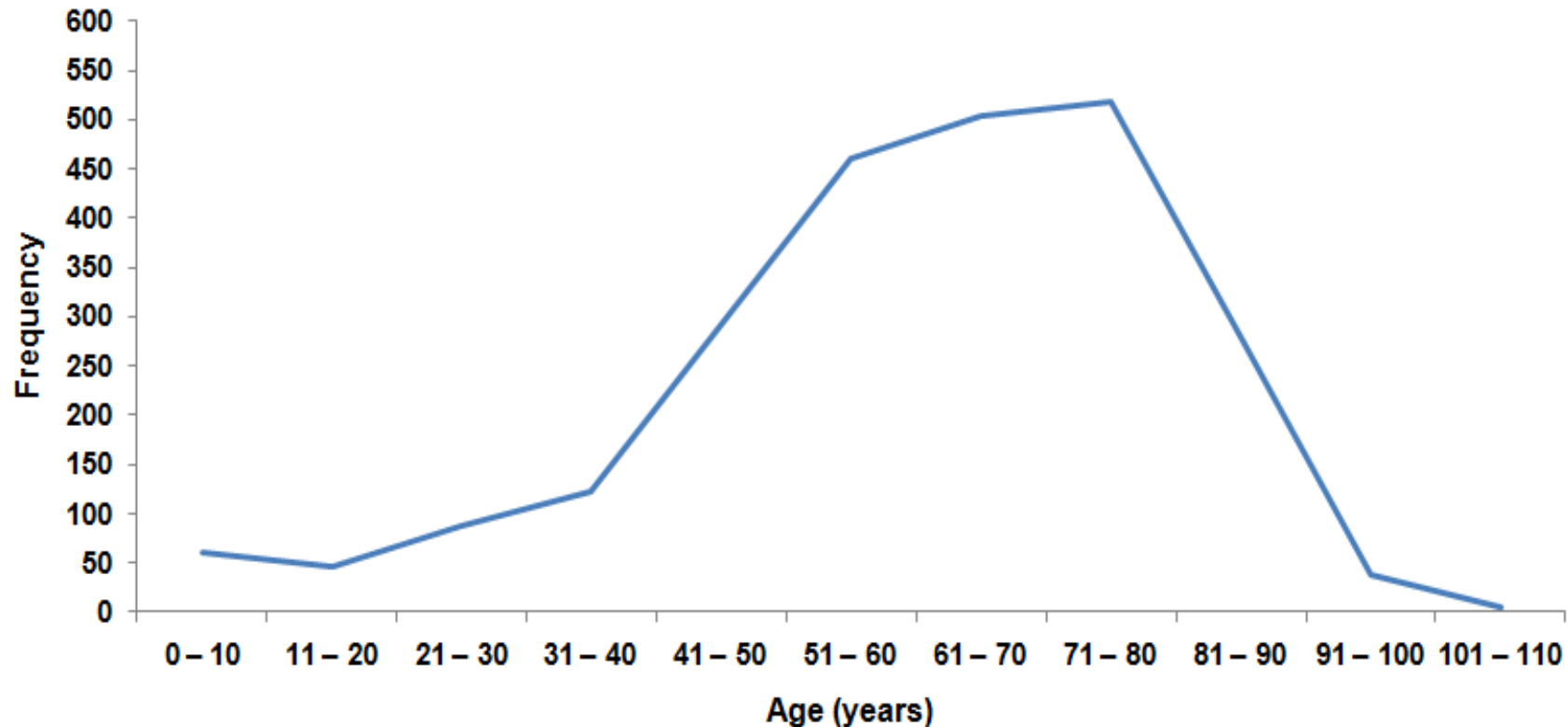
Cardiac Arrest and Resuscitation Epidemiology (CARE) Study

- ↓ *Largest and most comprehensive OHCA study to date*
- ↓ *CARE I: Epidemiology of OHCA in Singapore -1 Oct 2001 to 30 Apr 2002*
- ↓ *CARE II: Prospective clinical trial of adrenaline in OHCA -1 Oct 2002 to 14 Oct 2004*
- ↓ *CARE III: Geospatial analysis of ambulance demand - 1 January 2006 to 31 May 2006*
- ↓ *CARE IV: Smart Ambulance Deployment -Ongoing*
- ↓ *Pan Asian Resuscitation Outcomes Study (PAROS) >200,000 cases recruited*

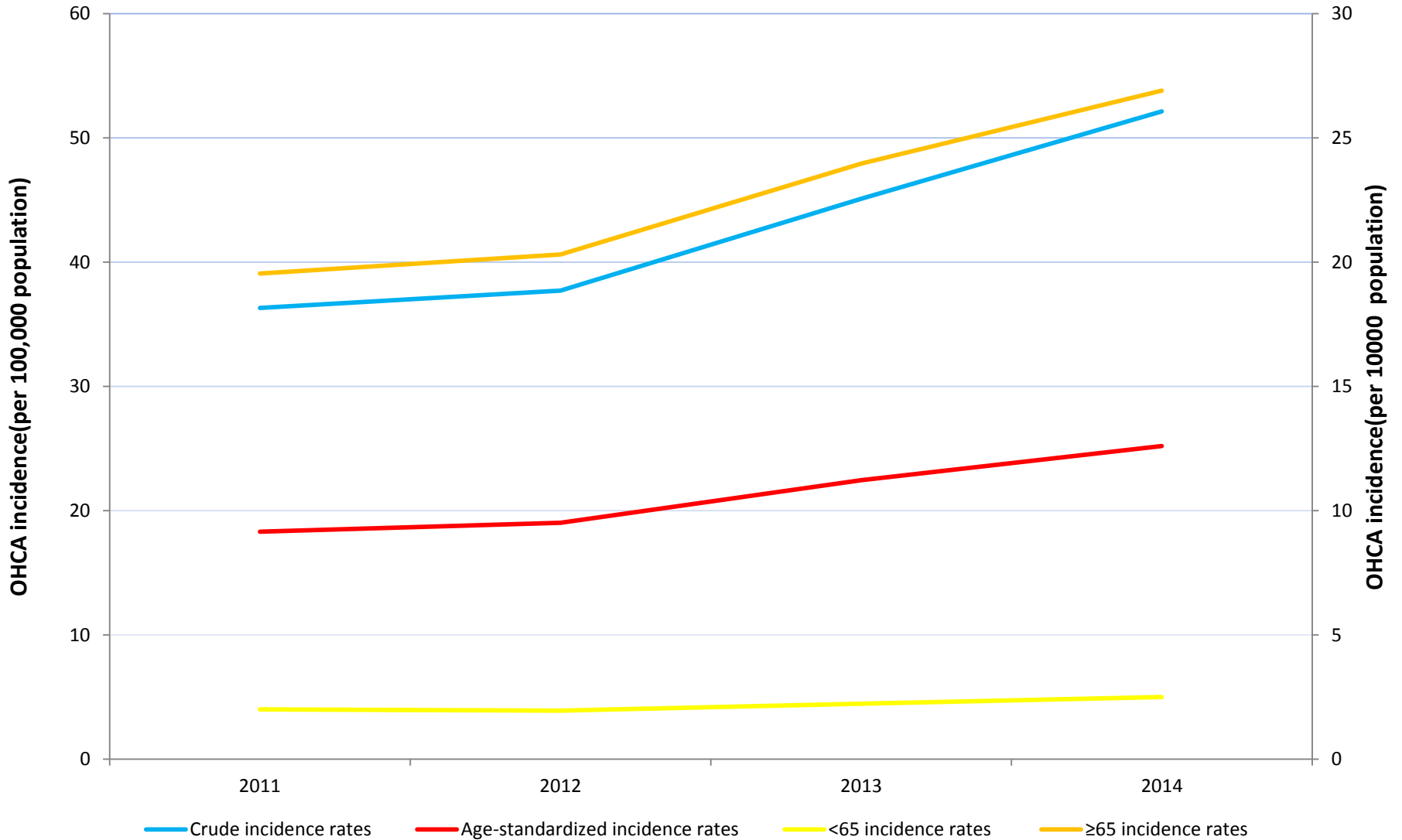


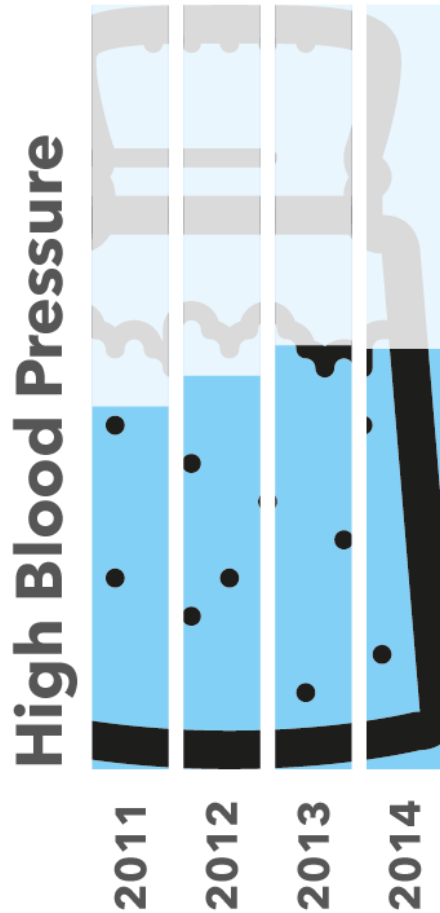
The Situation in Singapore.....

- **>2000** Out-of-Hospital Cardiac Arrest (OHCA) per year
- **65%** of OHCA Deaths were in Independent, Economically Active Patients Age <70



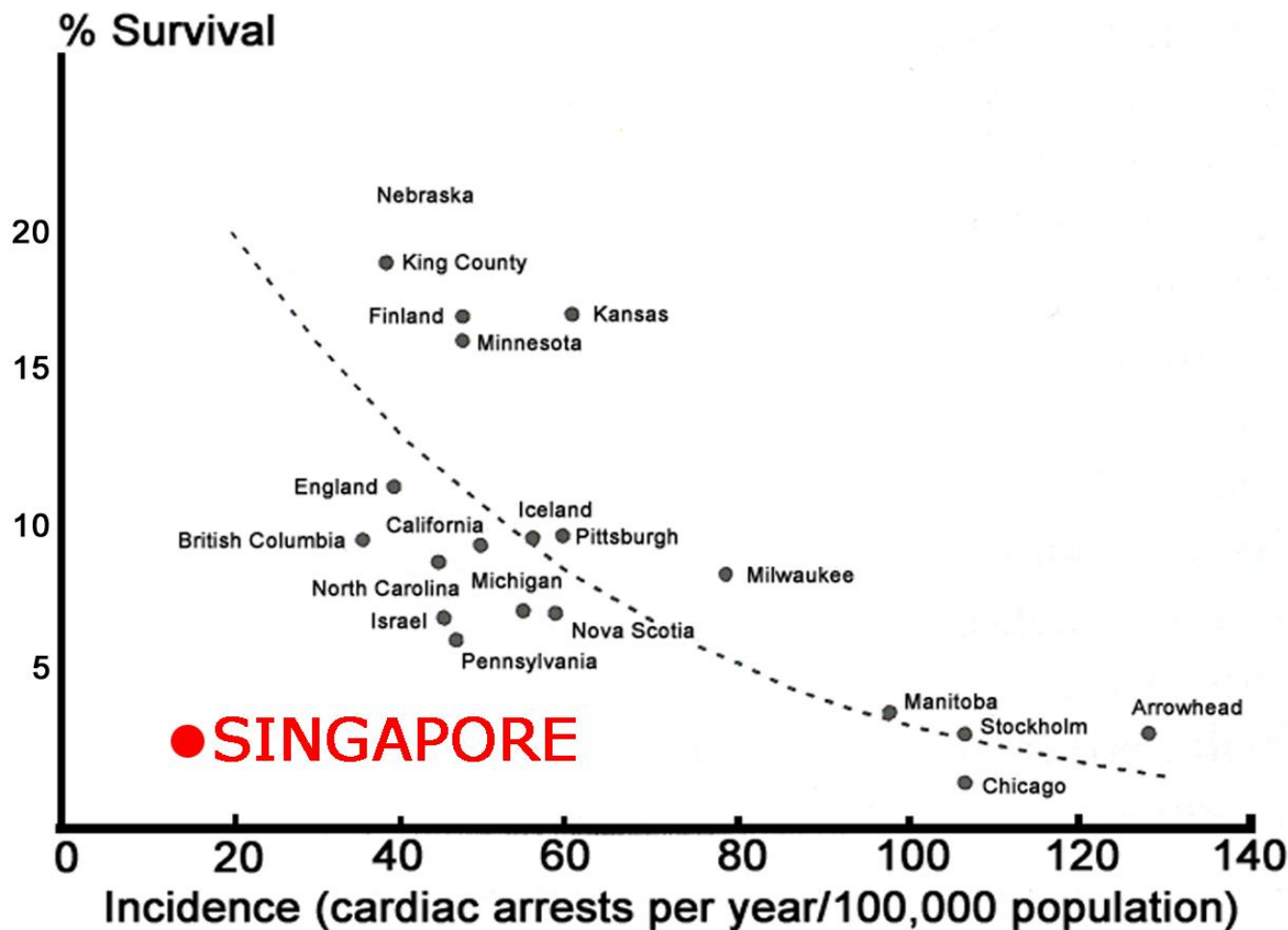
OHCA incidence in Singapore, 2011-2014





Prevalence of medical history among cardiac arrest by year, 2011 - 2014

CARE Study 2001



Incidence rate

↓ 1000 per year

↓ 15/100,000

Survival rate

↓ 2.0%

Understanding the “Chain of Survival”

Using the Chain of Survival

Rapid recognition and activation of EMS via 9-1-1.



Early use of automated external defibrillator (AED).



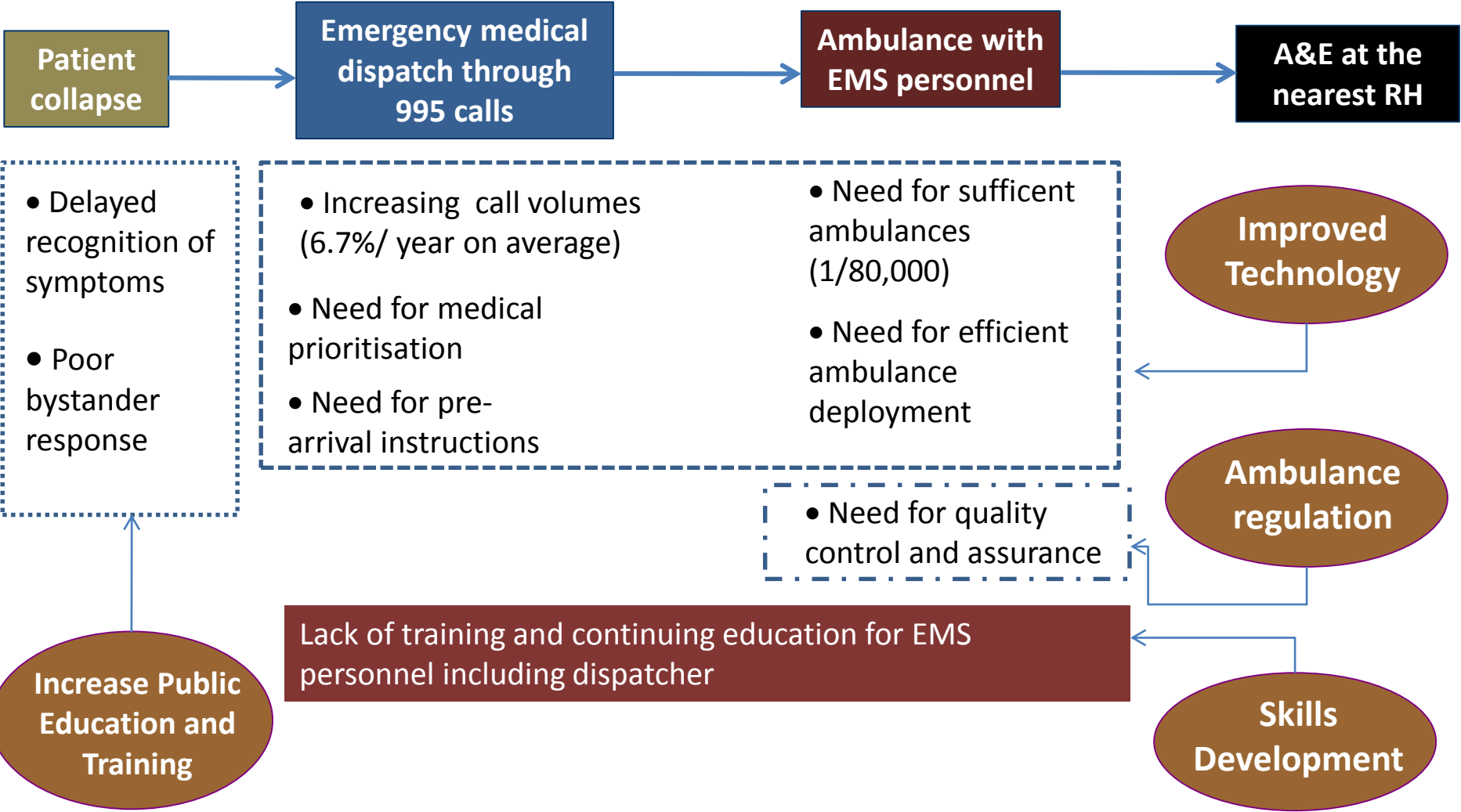
Early post-resuscitative care.



How can we improve survival?

**Outcomes are almost certainly due to
timeliness and quality of treatment**

Strategies to Improve Survival





Short communication

National population based survey on the prevalence of first aid, cardiopulmonary resuscitation and automated external defibrillator skills in Singapore[☆]

Marcus Eng Hock Ong^{a,b,*,+}, Joy Li Juan Quah^c, Andrew Fu Wah Ho^c, Susan Yap^a, Nausheen Edwin^a, Yih Yng Ng^d, E Shaun Goh^e, Benjamin Sieu-Hon Leong^f, Han Nee Gan^g, David Chee Guan Foo^h

^a Department of Emergency Medicine, Singapore General Hospital, Singapore

^b Office of Clinical Sciences, Duke-NUS Graduate Medical School, Singapore

^c Yong Loo Lin School of Medicine, National University of Singapore, Singapore

^d Medical Department, Singapore Civil Defence Force, Singapore

^e Acute and Emergency Care Centre, Khoo Teck Puat Hospital, Singapore

^f Emergency Medicine Department, National University Hospital, Singapore

^g Accident & Emergency Department, Changi General Hospital, Singapore

^h Department of Cardiology, Tan Tock Seng Hospital, Singapore

ARTICLE INFO

Article history:

Received 11 January 2013

Received in revised form 16 April 2013

Accepted 12 May 2013

Keywords:

Knowledge

Attitudes

Life-saving skills

CPR

First aid

AED

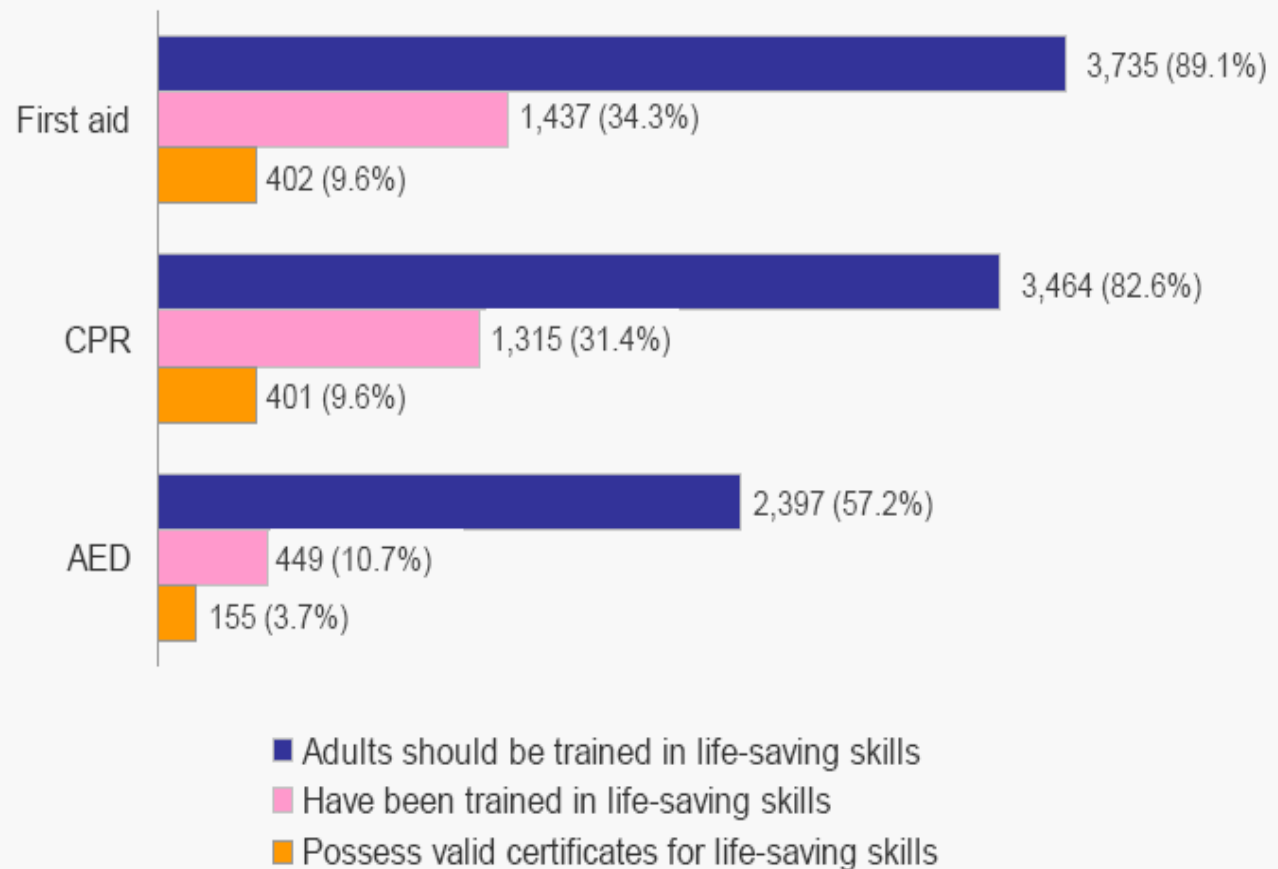
ABSTRACT

Aim: This study aimed to assess knowledge, attitudes and practices among Singapore residents towards life-saving skills and providing emergency assistance in the community using a population representative sample.

Methods: A population based, random sample of 7840 household addresses were selected from a validated national sampling frame. Respondents were interviewed using face-to-face interview method. One adult aged between 18 and 69 years within each household was randomly selected using the “next birthday” method.

Results: The response rate achieved was 65.2% with 4192 respondents. The distribution of age, gender and ethnic group were similar to the Singapore resident population for 2009. A high proportion of participants believed that adults should be trained in first aid (89.1%) and cardiopulmonary resuscitation (CPR) (82.6%) while a lower proportion (57.2%) believed this for automated external defibrillator (AED). Proportion who had ever been trained in first aid was 34.3%, CPR was 31.4% and AED was 10.7%. In an emergency, respondents were most willing to use life-saving skills on family members or relatives (87.6%), followed by friends and colleagues (80.7%) and complete strangers (61.3%). Common barriers to applying life-

State of CPR Training in our Population





Clinical paper

A before–after interventional trial of dispatcher-assisted cardio-pulmonary resuscitation for out-of-hospital cardiac arrests in Singapore[☆]



Sumitro Harjanto^a, May Xue Bi Na^b, Ying Hao^c, Yih Yng Ng^d, Nausheen Doctor^e, E. Shaun Goh^f, Benjamin Sieu-Hon Leong^g, Han Nee Gan^h, Michael Yih Chong Chiaⁱ, Lai Peng Tham^j, Si Oon Cheah^k, Nur Shahidah^e, Marcus Eng Hock Ong^{e,1,*}
For the PAROS study group

^a Duke-NUS Medical School, Singapore, Singapore

^b Yong Loo Lin School of Medicine, National University of Singapore, Singapore, Singapore

^c Division of Research, Singapore General Hospital, Singapore, Singapore

^d Medical Department, Singapore Civil Defence Force, Singapore, Singapore

^e Department of Emergency Medicine, Singapore General Hospital, Singapore, Singapore

^f Department of Acute and Emergency Care, Khoo Teck Puat Hospital, Singapore, Singapore

^g Emergency Medicine Department, National University Hospital, Singapore, Singapore

^h Accident & Emergency, Changi General Hospital, Singapore, Singapore

ⁱ Emergency Department, Tan Tock Seng Hospital, Singapore, Singapore

^j Children's Emergency, KK Women's and Children's Hospital, Singapore, Singapore

^k Emergency Medicine Department, Alexandra Hospital, Singapore, Singapore

¹ Health Services & Systems Research, Duke-NUS Medical School, Singapore, Singapore

ARTICLE INFO

Article history:

Received 30 July 2015

Received in revised form 10 February 2016

Accepted 17 February 2016

Keywords:

Dispatcher-assisted

Cardiopulmonary resuscitation

Survival

Cardiac arrest

ABSTRACT

Aim: To evaluate the effects of a comprehensive dispatcher-assisted CPR (DACPR) training program on bystander CPR (BCPR) rate and the outcomes of out-of-hospital cardiac arrest (OHCA) in Singapore.

Methods: This is an initial program evaluation of a national DACPR intervention. A before–after analysis was conducted using OHCA cases retrieved from a local registry and DACPR information derived from audio recordings and ambulance notes. The primary outcomes were survival to admission, survival at 30 days post-arrest and good functional recovery.

Results: Data was collected before the intervention (April 2010 to December 2011), during the run-in period (January 2012 to June 2012) and after the intervention (July 2012 to February 2013). A total of 2968 cases were included in the study with a mean age of 65.6. Overall survival rate was 3.9% (116) with good functional recovery in 2.2% (66) of the patients. BCPR rate increased from 22.4% to 42.1% ($p < 0.001$) with odds ratio (OR) of 2.52 (95% confidence interval [CI]: 2.09–3.04) and ROSC increased significantly from 26.5% to 31.2% ($p = 0.02$) with OR of 1.26 (95%CI: 1.04–1.53) after the intervention. Significantly higher survival at 30 days was observed for patients who received BCPR from a trained person as compared to no BCPR ($p = 0.001$, OR = 2.07 [95%CI: 1.41–3.02]) and DACPR ($p = 0.04$, OR = 0.30 [95%CI: 0.04–2.18]).

Conclusion: A significant increase in BCPR and ROSC was observed after the intervention. There was a trend to suggest improved survival outcomes with the intervention pending further results from the trial.

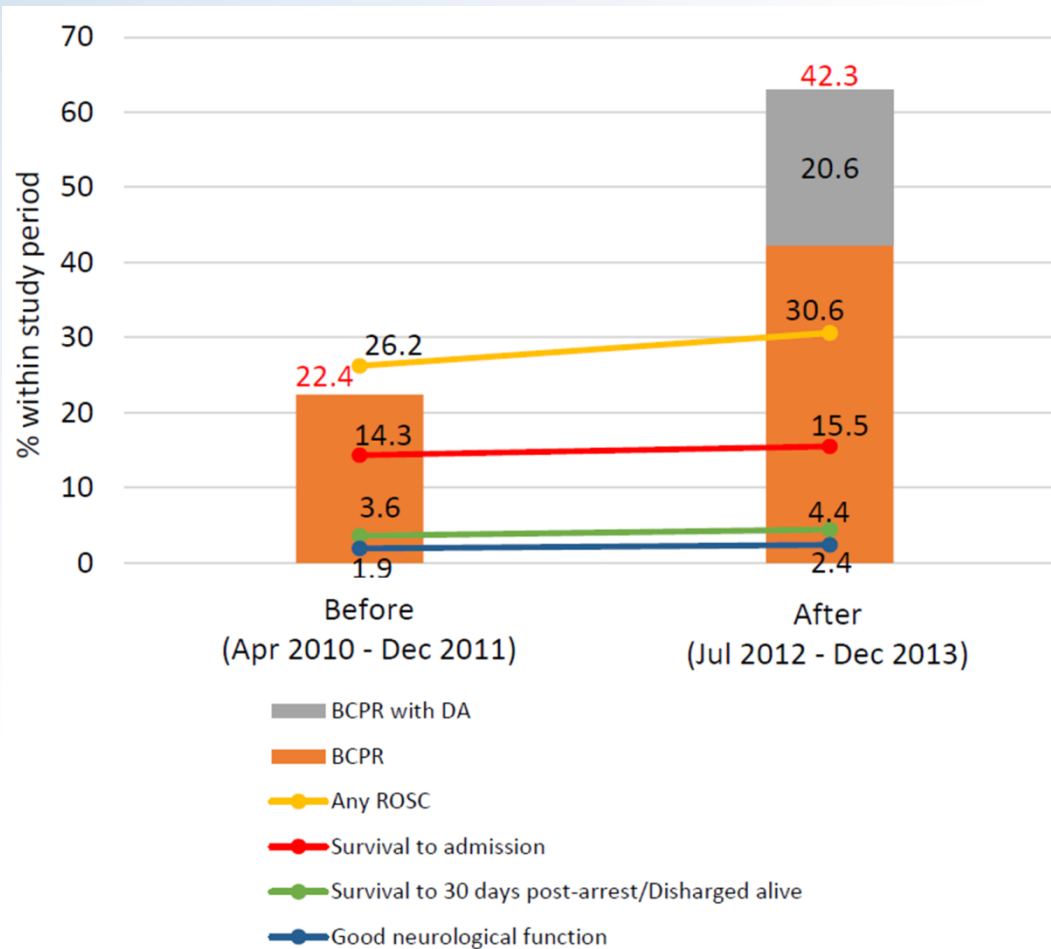


Improving Access - 995

- Ambulance is on the way, stay on the line
- Dispatcher will give instructions for CPR
- Keep doing CPR till ambulance arrives



Bystander CPR has doubled





Bystander CPR and OHCA survival:

Six regions of Singapore saturated with
trained and equipped volunteers with
AED access



UPEC

Unit for Pre-hospital Emergency Care (UPEC)

Dispatcher-Assisted First Responder Programme (DARE)



ST PHOTO: DESMOND FOO

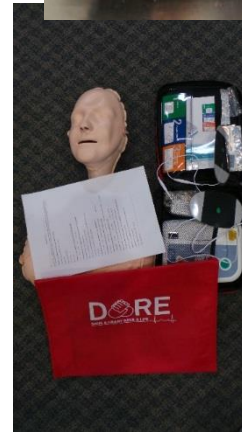
HOME B8

LEARN CPR? THEY'RE ALL EARS

You are never too young to learn how to save lives.

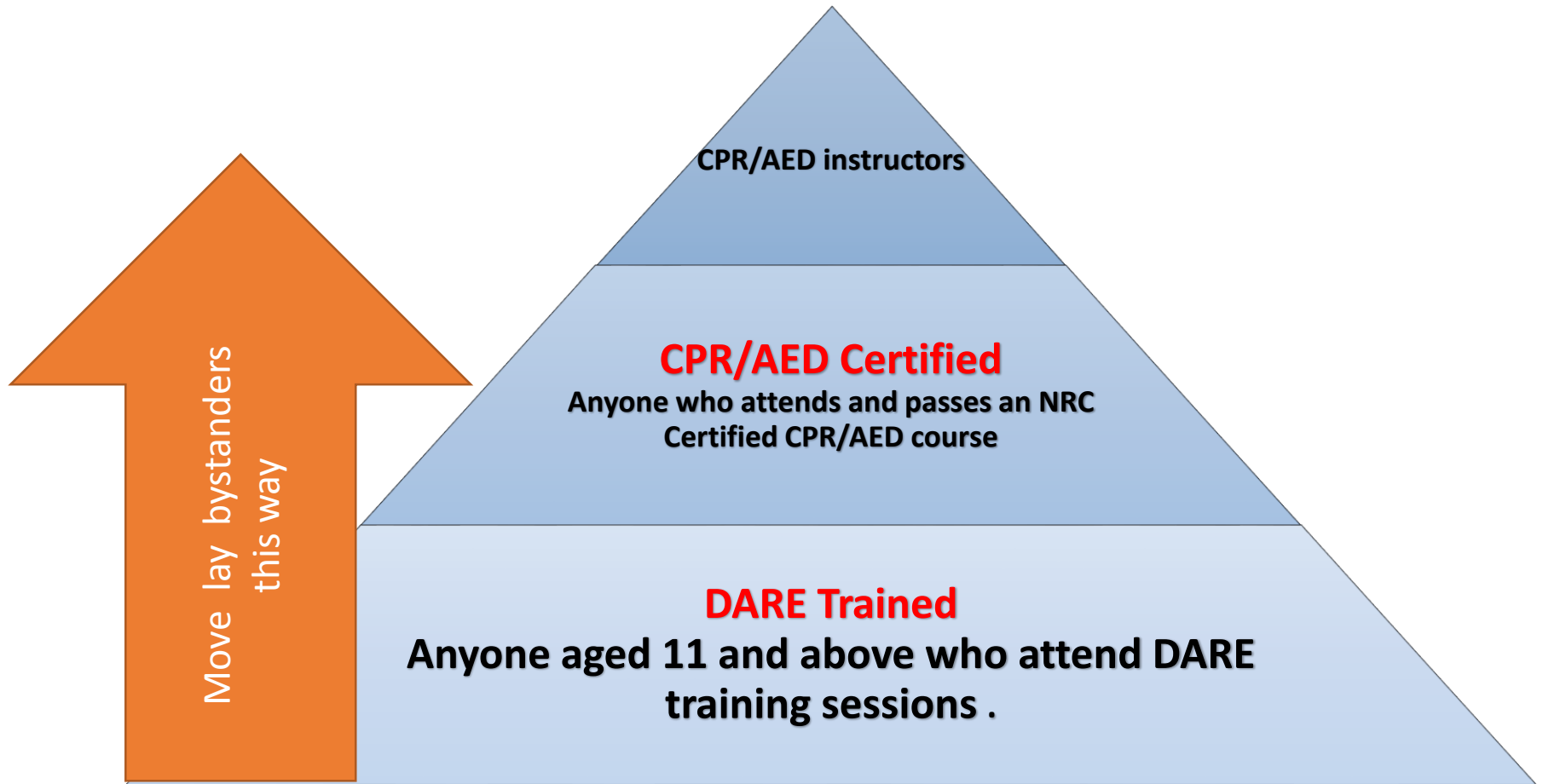
Pupils at St Anthony's Primary School proved just that yesterday when they learnt how to administer

cardiopulmonary resuscitation (CPR) and use an automated external defibrillator. About 2,300 students have attended this life-saving programme so far.

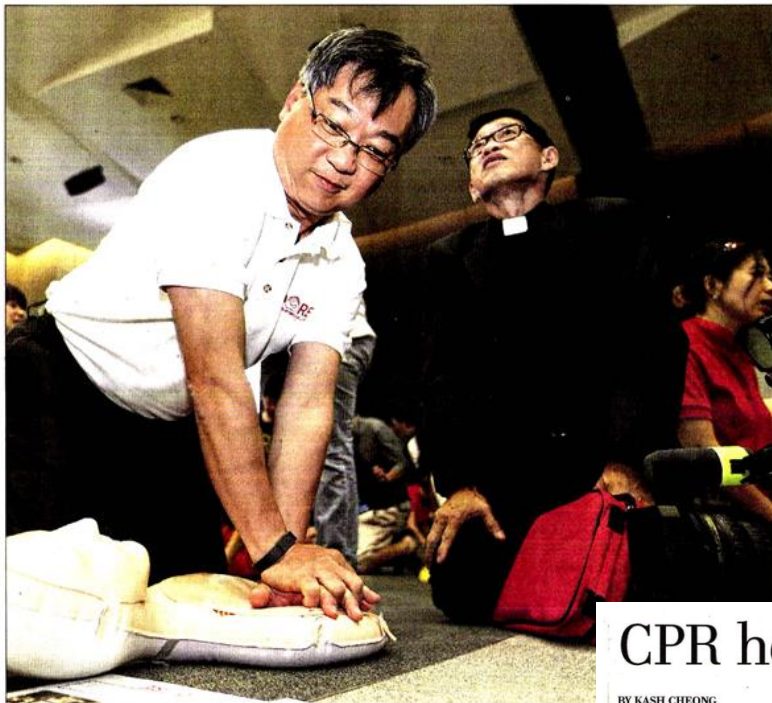




Pyramid of First Responder Preparedness



DARE Aware: Everyone becomes aware of what we teach in DARE through social media, traditional media, or by word of mouth.



Health Minister Gan Kim Yong (left) and Reverend Derrick Lau at a simplified CPR training session of the Incarnation. The training is being extended to religious organisations and workplaces. ST

Big push to get more people trained in CPR

Goal: At least one person in every home trained in simplified technique

By SAMANTHA BOH

A BIG push is being made to get at least one person in every household trained in a simplified cardiopulmonary resuscitation (CPR) procedure.

The Unit for Pre-Hospital Emergency Care (Upec) has given itself five years to do it, said its medical director Marcus Ong.

The plan is to extend the Dispatcher Assisted first Responder, or Dare, programme to religious organisations and workplaces, he said. Till now, the year-old programme has been making the

willing and able to respond in an emergency," he said.

Around 1,800 cardiac arrests occur in Singapore every year, but only 3 per cent of the victims survive them.

The Dare programme can be learnt in an hour and participants are taught CPR in simple, easy-to-follow steps: dial 995, stay on the line with a medical dispatcher, and perform CPR using an automated external defibrillator.

Dare focuses on chest compressions, which have been found to be more crucial than

Yesterday, members of the Methodist Church of the Incarnation in Choa Chu Kang became the first among religious groups to be trained.

Sixty church-goers were given a quick session after their morning church service.

Health Minister Gan Kim Yong, who was guest of honour, however, encouraged participants to learn the standard CPR, which included mouth-to-mouth ventilation.

He added that it was the preferred method for cardiac arrest in children and in drowning cases.

He also noted that most out-of-hospital cardiac arrests happen in the victim's home or places he frequents, often in the presence of relatives, friends or neighbours.

"(So) by preparing for the unexpected, the skills acquired today end up saving lives of someone we know or someone we love the future if we dare to step

" he said.
amboh@sph.com.sg

CPR helpline a real life-saver

By KASH CHEONG

MORE people are surviving cardiac arrests in Singapore – and it's not just down to doctors.

Friends, loved ones and even strangers are increasingly performing cardiopulmonary resuscitation (CPR) on cardiac arrest victims.

The emergency procedure involves chest compressions and giving a "kiss of life", which can be crucial in saving a victim.

Four years ago, only two out of 10 cardiac arrest patients received CPR from a bystander. But this number has doubled, largely thanks to a phone service which lets 995 callers get step-by-step CPR instructions from health-care staff until an ambulance arrives.

It was launched in 2012 by the Ministry of Health's Unit for Pre-Hospital Emergency Care, the Singapore General Hospital (SGH) and the Singapore Civil Defence Force.

Survival rates have also increased from 3.6 per cent to 4.6 per cent over the last four years, which is "good progress", according to Marcus Ong, senior consultant at SGH's department of emergency medicine.

After a person collapses, his chances of surviving falls by 10 per cent every minute.

In Singapore, it takes an average of 10 minutes for an ambulance to arrive and 46 minutes before the patient gets to hospital. Paramedics may perform additional treatment along the way.

"If you are relying on paramedics or hospital doctors to save a cardiac arrest patient, it might be too late. Bystander CPR really gives the patient a fighting chance," said Associate Professor Ong.

He was speaking on Wednesday at SGH's Survivor Awards event, which honours cardiac arrest patients and their life-savers.

However, Dr Ong believes more can be done to increase survival rates for a condition which affects 1,800 people here every year.

"In places like Seattle, Washington, survival rates are about 20 per cent," he added. "Most strangers would perform CPR on others and kids learn how to do it in school."

He attributed the higher survival rates there to good school and community outreach, which have been ongoing for 60 years.

In Singapore, the People's Association and the National Resuscitation Council are training the public and grassroots leaders, while schools like Victoria Junior College also teach the life-saving procedure.

By 2020, Dr Ong aims to have someone trained in CPR in every household. However, there are barriers to this – such as people being deterred by having to resuscitate someone they have never met.

Pointing out that eight out of 10 cardiac arrest cases happen at



LUCKY: Ms Tan called 995 when she saw her mother's eyes roll up and tongue hang out last year. A calm voice talked her through the CPR process. Madam Lee survived and it prompted her husband, Mr Tan, to sign up for a CPR course. PHOTO: THE STRAITS TIMES

home, he added: "If it's a stranger on the street, people think, 'Why should I bother?' But, if you learn CPR, more often than not, you might end up saving a loved one."

Nurse Amanda Tan did just that. When the 31-year-old saw her mother's eyes roll up and tongue hang out last year, she panicked and called 995. A calm voice over the phone talked her through the process.

"Even though I had learnt CPR, at that moment, I was in a daze," she said. "It really helps you compose your thoughts and remember what to do."

Her mother, Lee Mary Ann, survived the ordeal. It prompted her father, Eric Tan, to sign up for a CPR course. "My mother said she was lucky to survive," said Ms Tan. "But we are even luckier to have her back."

kashc@sph.com.sg

MediaCorp



SINGAPORE
TONIGHT



Dial 995 and send your geo-location at the same time

1

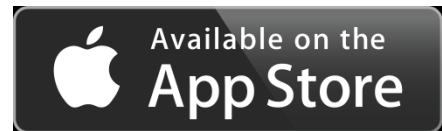


3



2

Know where the nearest AED is located



Sign up as a volunteer responder





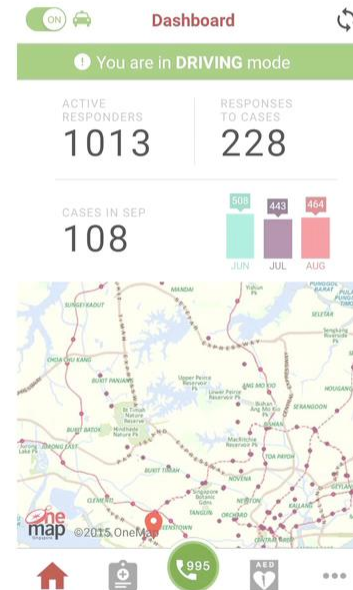
AED Installation by SCDF

- SCDF installing 385 AEDs near lifts
- Trainees will be informed of the nearest unit



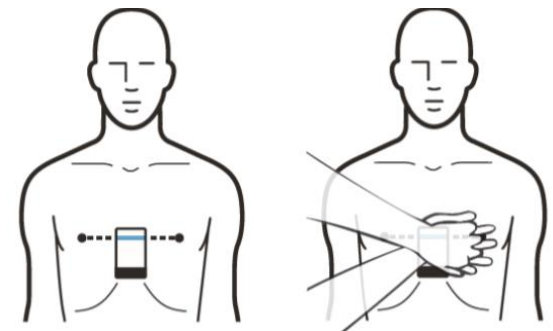
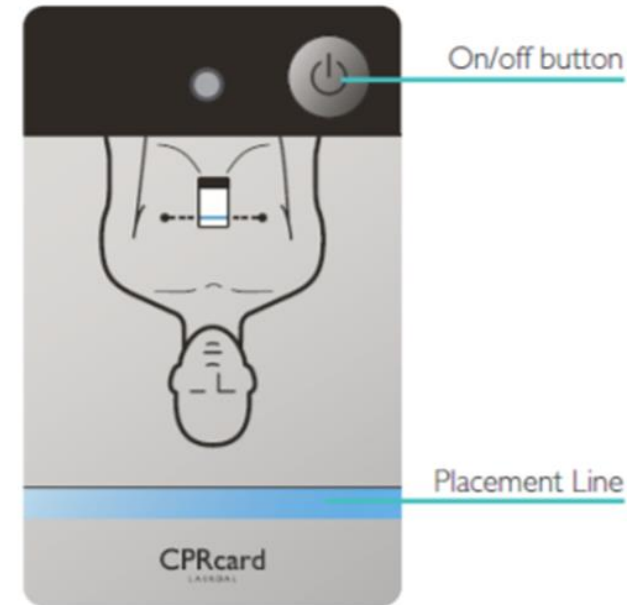
AED on Wheels Program

AED On Wheels



The CPRcard™

- Personal credit card size device
- Assists with land-marking
- Provides visual rate and depth range of compressions
- Collects data re: quality of chest compressions



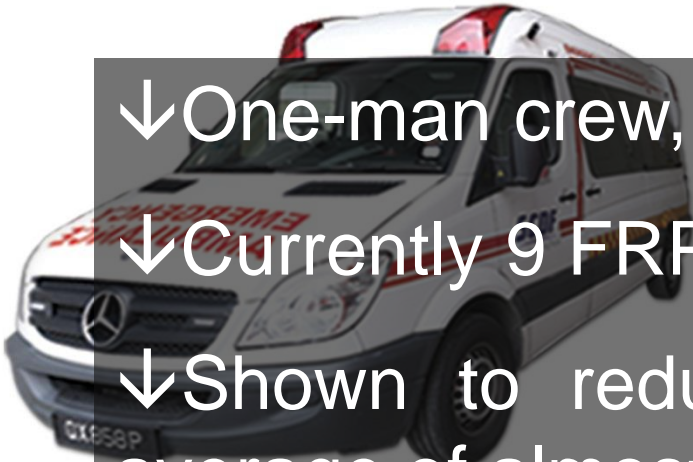
Emergency Medical Services (EMS) System

- ↓ Run by the Singapore Civil Defence Force
- ↓ Currently operating 46 ambulances in 14 stations and 10 satellite stations
- ↓ Single tier system
- ↓ Able to provide BCLS and defibrillation using Automated External Defibrillators (AEDs)

Singapore: preparedness in a tightly packed community

Fast Response Paramedic (FRP)

- ↓ One-man crew, equipped with AED
- ↓ Currently 9 FRPs in service
- ↓ Shown to reduce response times by an average of almost 5 minutes
- ↓ Adding more Firebiker units



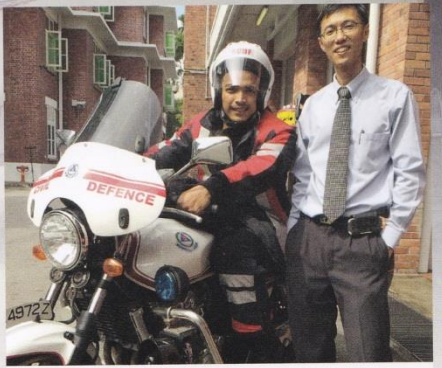
...ing and developing a strong Chain of Survival in... demands innovative use of existing resources. In... d 12 square metres... an ambulance will arrive after 40 minutes... responders have failed to act – and need 46 minutes to... the patient to the hospital. Moreover, lifts in its high-rise... towers typically have no place for a stretcher or a gurney.

...measures that are lifting this bustling city to be among... survival include the multi-disciplinary... assisted... that... a trained and confident bystander in every house... well-equipped paramedics using motorcycles to move... through traffic, and special smart phone emergency apps... community responders to rush in with the... PRcard for lay people is being... Singapore. Key leaders have realized that precisely the... of the population provides great opportunities. Because... generations often live together, most cases will entail the... really close.

...the inspiration came from Seattle. Marcus Ong Eng... PAROS – Pan Asian Resuscitation Outcomes... is a driving force in Asian lifesaving... advocates more and better bystander CPR, while... build up one of the world's largest cardiac arrest registers... more than 30,000 cases a year. This enables the... and deficiencies of each... and Quality... processes to improve outcome.

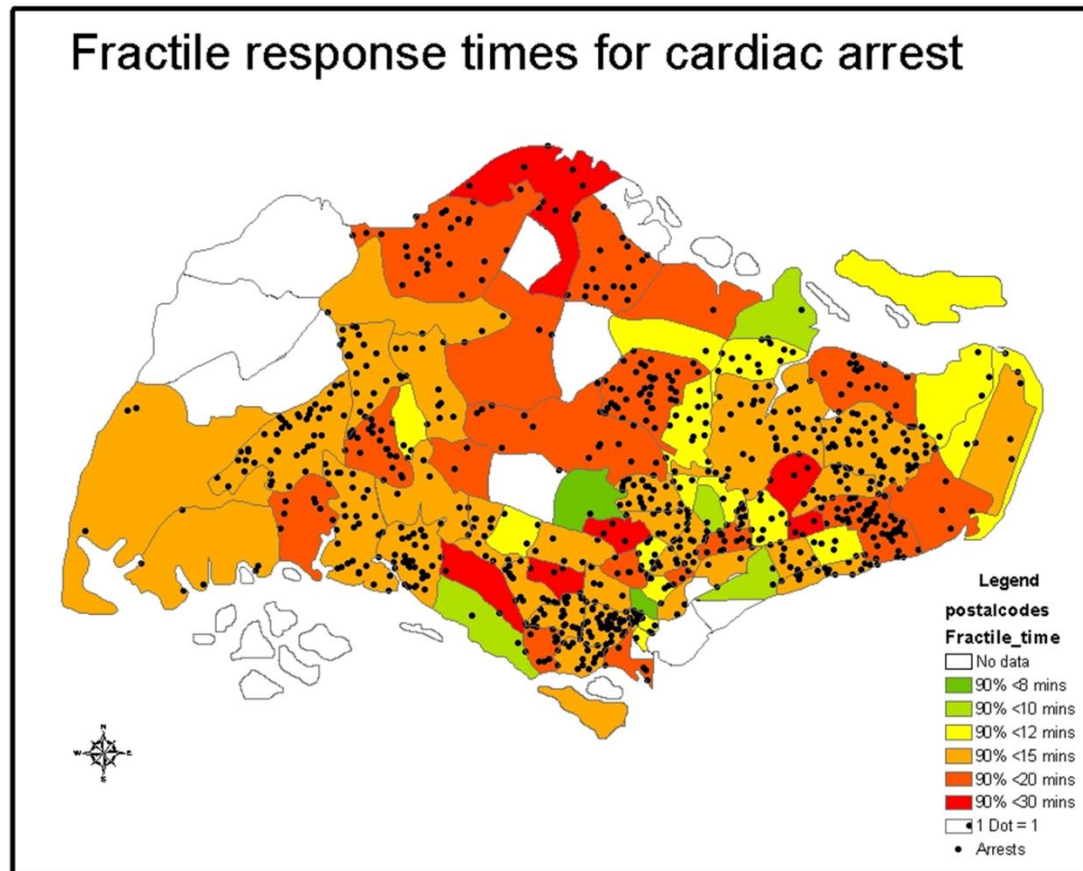
...The network is growing quickly, and by hundreds of million... South Korea, Thailand, the Philippines, and Japan are... of the PAROS network, and plans are being prepared... China, Indonesia, Pakistan, and Qatar in adopting... dispatcher-assisted CPR intervention package.

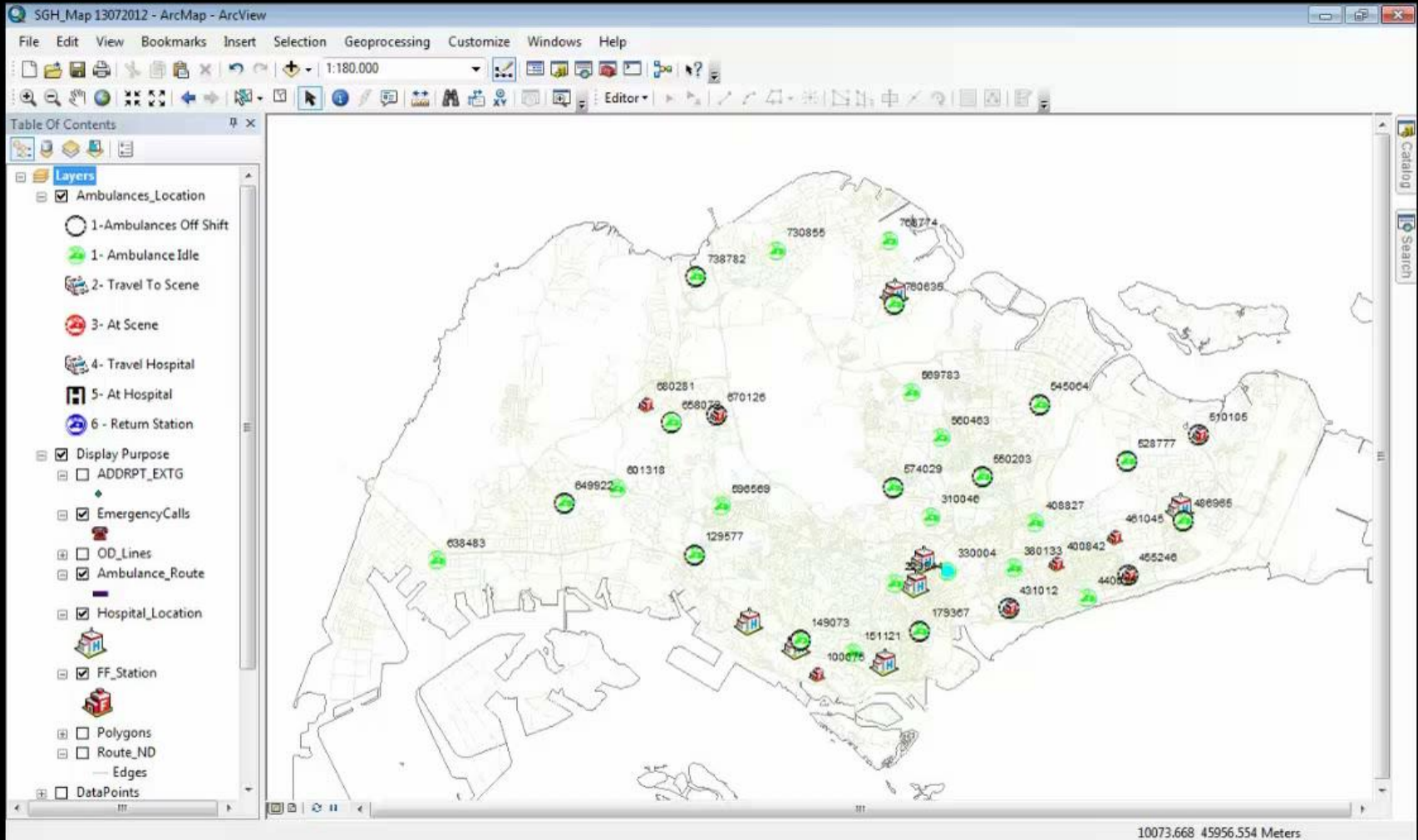
...“The key to success is determined and enthusiastic local leader...” says Marcus Ong. The initiative must come from each... when a community realizes that it has a problem and... collaboration to solve it. Moreover, fast-progressing... Singapore and Seoul are cultures where people have a strong... will to improve and are ready to contribute to the community.



Marcus Ong with motorbike ambulance paramedic.

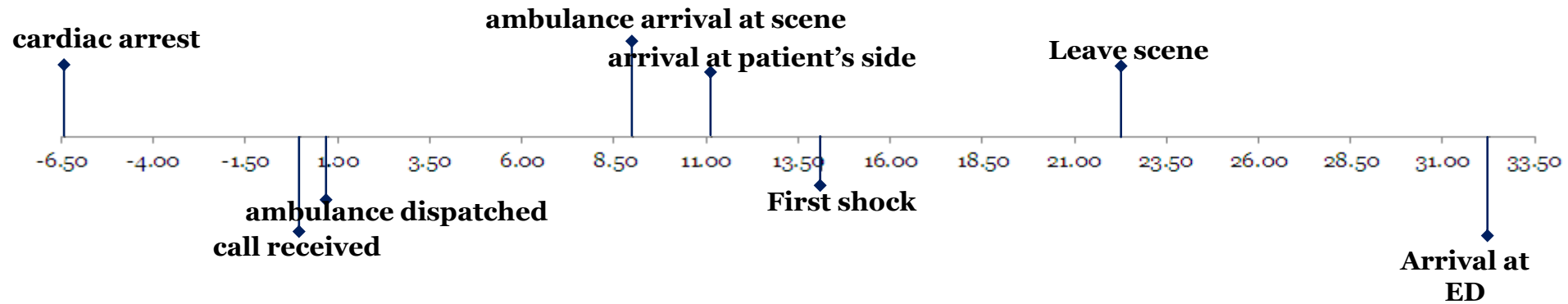
Improving Ambulance Response Times and Out of Hospital Cardiac Arrest Outcomes in Singapore with the Implementation of a Systems Status Plan



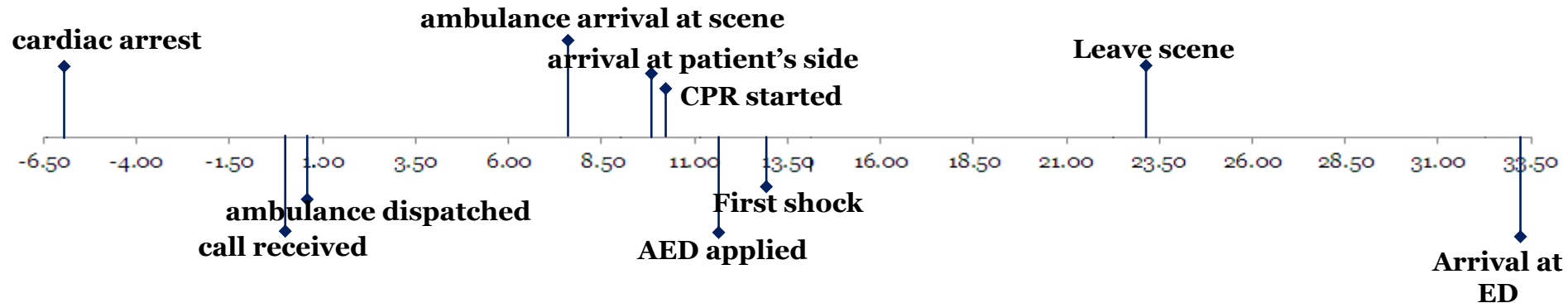


Timeline

CARE timeline of OHCA (October 2001 - October 2004)

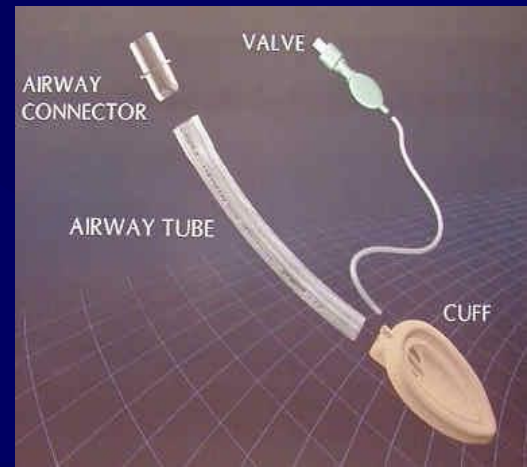


PAROS timeline of OHCA (April 2010 - May 2012)

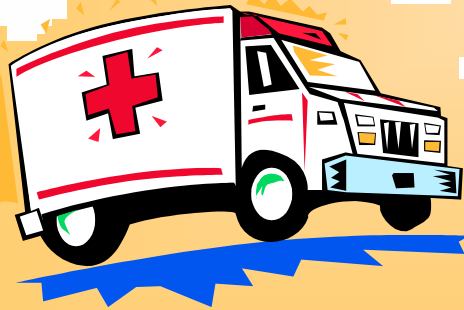


Early basic and advanced care

- Oxygen
- Airway adjuncts
- IV fluids
- Laryngeal mask airway
- Aspirin (Oral)
- GTN
- Adrenaline (intravenous)
- Intraosseous Devices
- Mechanical CPR



***Survival Outcomes with the
Introduction of Intravenous
Adrenaline in the Management of
Out-of-Hospital Cardiac Arrest
(CARE II Study)***



Dr Marcus Ong Eng Hock

MBBS, FRCS (A&E) Ed, MPH (VCU), FAMS

Consultant, Director of Research and Senior Medical Scientist

Dept of Emergency Medicine, Singapore General Hospital

Intraosseous Vascular Access for Cardiac Arrest: RCT

A shot in the leg bone to save cardiac arrest victims

By KASH CHEONG



A paramedic demonstrates how a small drill-needle can be inserted into the leg bone below a patient's knee cap. This will be used to inject a shot of adrenaline to save a person who has suffered cardiac arrest.

PHOTO: LIANHE ZAOBAO

PARAMEDICS here are testing a new way to get adrenaline to the heart of cardiac arrest victims – by drilling below the knee.

The Singapore Civil Defence Force (SCDF) and the Singapore General Hospital hope this could raise survival rates.

During a cardiac arrest, adrenaline, in addition to cardiopulmonary resuscitation (CPR) or an electric shock, is used to stimulate the heart and make it pump again, said Associate Professor Marcus Ong, senior consultant at SGH's Department of Emergency Medicine.

The adrenaline is usually delivered through an intravenous line in a vein in the arm. However, this is a challenge, explained SCDF's chief medical officer Ng Yih Yng.

"It's hard for paramedics to find the vein. It is flat during a cardiac arrest since there is no blood pumping through," he said.

Now, if intravenous insertion is not possible, paramedics will insert a 25mm-long needle into the leg bone below the patient's knee cap. This will be used to

drill a small hole in the bone, which allows access to the bone marrow underneath, which connects to the body's circulatory system.

A shot of adrenaline, which is meant to constrict veins and restore blood flow, is then delivered into the bone marrow using a syringe.

This method could work more than 90 per cent of the time, compared to 50 per cent for the intravenous line, said Colonel Dr Ng. "The patient does not feel any pain because he would be unconscious during a cardiac arrest."

Paramedics will use the drill only if they fail to insert an intravenous line after two attempts, Prof Ong said.

The drill method is more expensive as each of these one-time-use drill-needles costs about \$200, while intravenous lines cost less than \$2.

From this month, SCDF and SGH will evaluate the effectiveness of the drill method on 400 cardiac arrest patients, and test if the benefits outweigh the cost.

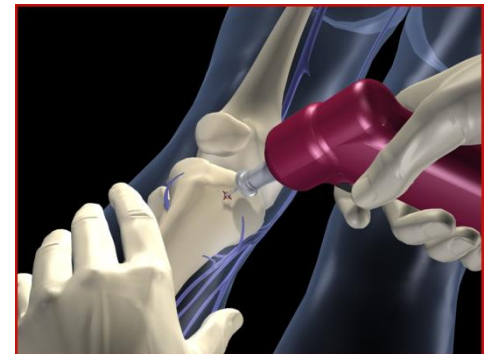
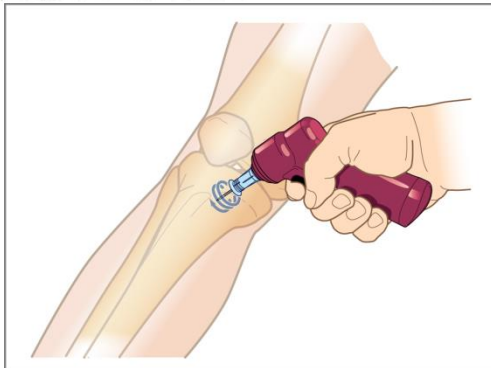
Over 160 SCDF paramedics have been trained to use the medical drill, which is already used in public hospitals here.

Every year, about 1,800 people here collapse from cardiac arrest outside the hospital. About 3 per cent

survive.

"Hopefully, we can bring up survival rates if we are able to get the life-saving adrenaline to them in a more effective way," said Prof Ong. "The public also has an important role in saving a life, by starting CPR as soon as possible."

✉ kashc@sph.com.sg





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A Randomised, Double-Blind Multi-centre Trial Comparing Vasopressin and Adrenaline in Patients with Cardiac Arrest at the Emergency Department. (Preadmission Intravenous Vasopressin, adrenaline Outcome Trial)

NMRC grant :PIVOT study \$105,840 (Principal investigator)



CTERU grant for Stability of Intravenous Adrenaline and Vasopressin in a Tropical Ambulance Environment: \$3,000 (Principal investigator)

Therapeutic Hypothermia Treatment



Cooling the body can 'cut risk of fatality' after cardiac arrest

By POON CHIAN HUI

CARDIAC arrest sufferers can be kept alive using a new technique that cools their bodies to below the normal temperature and then slowly reheats them.

The "therapeutic hypothermia" treatment more than triples their chances of surviving, according to preliminary results of a clinical trial in Singapore.

It also reduces the risk of brain damage – a common problem among those who live.

The technique – which is already used in countries such as Australia – spells new hope for the 1,500 people in Singapore who suffer a cardiac arrest outside hospital every year.

At the moment, their survival rate is a dismal 2.7 per cent.

First, the patient's body is rapidly cooled to between 32 deg C and

34 deg C. This is done either by wrapping large cooling-gel pads around the torso and legs or by pumping cool saline into a catheter that is inserted into the body.

The temperature is then maintained for 24 hours while the patient is put into a medically induced coma.

After that, the body is gradually warmed to the normal 36.5 deg C.

Bringing the temperature down helps to save barely alive cells, said Associate Professor Marcus Ong, who is the lead researcher in the trial at Singapore General Hospital (SGH).

This is because when oxygen is cut off during a cardiac arrest, "it starts a chain reaction that ultimately leads to cell death".

But when the cells are cooled, they do not need as much oxygen, which reduces the damage.

"If left alone, the area of dam-

age would increase and becomes permanent," added Prof Ong, a senior consultant in emergency medicine at the hospital.

Forty cardiac arrest patients aged 18 to 80 were involved in the clinical trial between 2008 and last year.

Most of the survivors given conventional intensive care ended up in a coma or vegetative state.

By contrast, more than half of the patients who received the hypothermia treatment woke up with minimal brain damage.

They include information technology manager Peng Hua, who collapsed suddenly at work last September.

Colleagues and paramedics managed to resuscitate him. And by the time the 39-year-old arrived at hospital, his heart had started beating again.

He was then cooled and slowly

*"Therapeutic hypothermia" lowers the body temperature and protects neurological function
----> survival increased from 16% (4 survivors) to 44% (11 survivors) .*

Pilot prospective study of therapeutic hypothermia for treatment of post-cardiac arrest patients. Ng M, Wong AS, Chew HC, Shahidah N, Pek PP, Poh J, Chin CT, Chua TS, Ong ME. Int J Cardiol. 2014 May 15;173(3):612-3

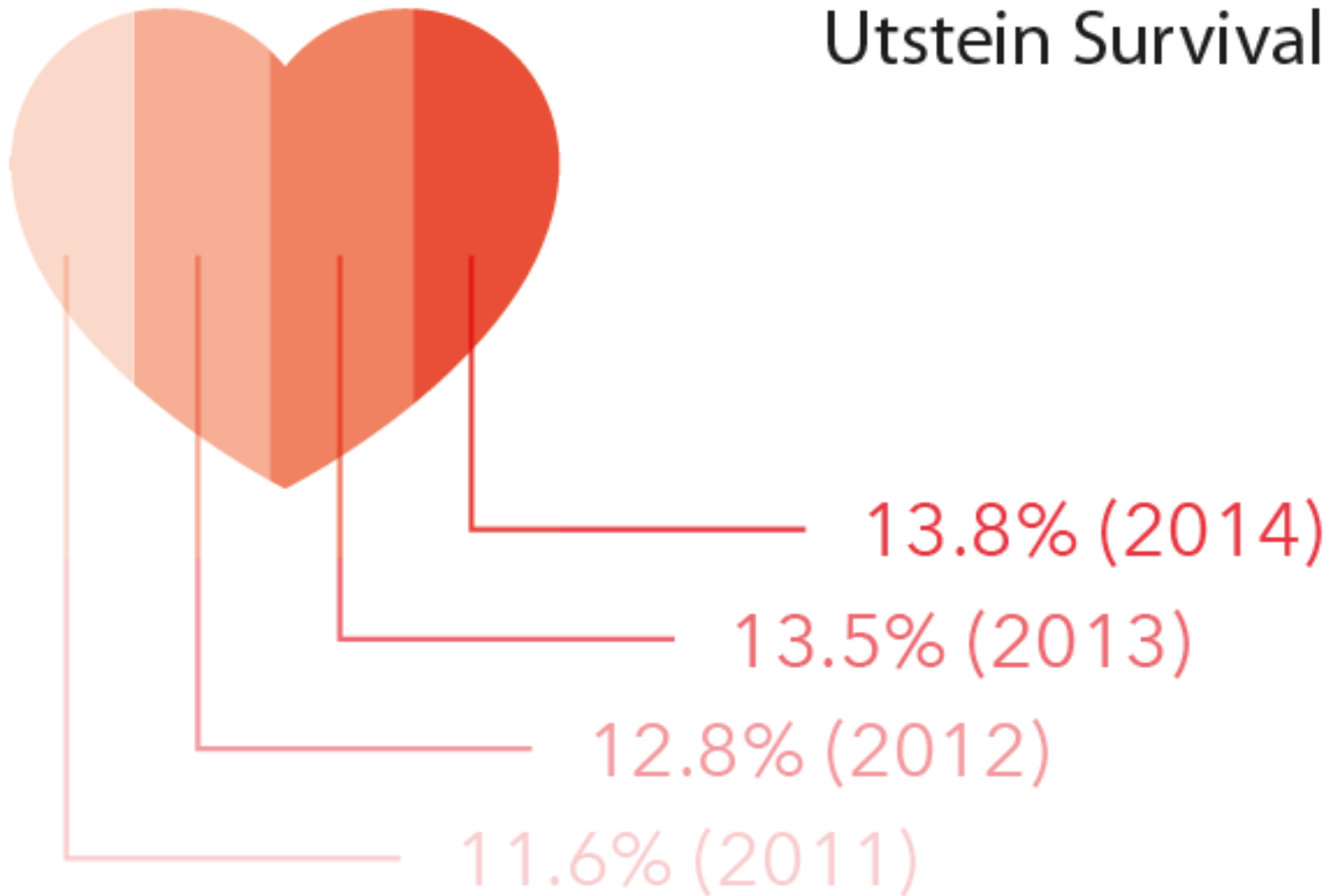
Improved OHCA survival over 10 years

	2001-2004 n=2428	2010-2012 n=3026	Adjusted OR* (95% CI)
<i>Survival - All Arrests</i>			
Discharged alive or Alive at 30 days	38 (1.6%)	97 (3.3%)	2.2 (1.5 - 3.3)
Good neurological function	28 (1.2%)	53 (1.8%)	1.7 (1.1 - 2.8)
<i>Survival - Utstein Style</i>			
Discharged alive or Remain alive at 30 days	7/280 (2.5%)	35/317 (11.0%)	9.6 (2.2 – 41.9)
Good neurological function	6/280 (2.1%)	22/317 (7.0%)	6.0 (1.3 – 27.0)

*adjusted for age, gender, and history of heart disease

Choong CV, Lai H, Fook-Chong, Goh ES, Leong BSL, Gan HN, Foo DCG, Tham LP, Rabind C, Ong MEH. Improvements In Survival For Out-of-hospital Cardiac Arrests In Singapore Over 10 Years. Singapore Cardiac Society Annual Meeting 2013, Singapore. 3rd Prize for Oral Presentation

Utstein Survival



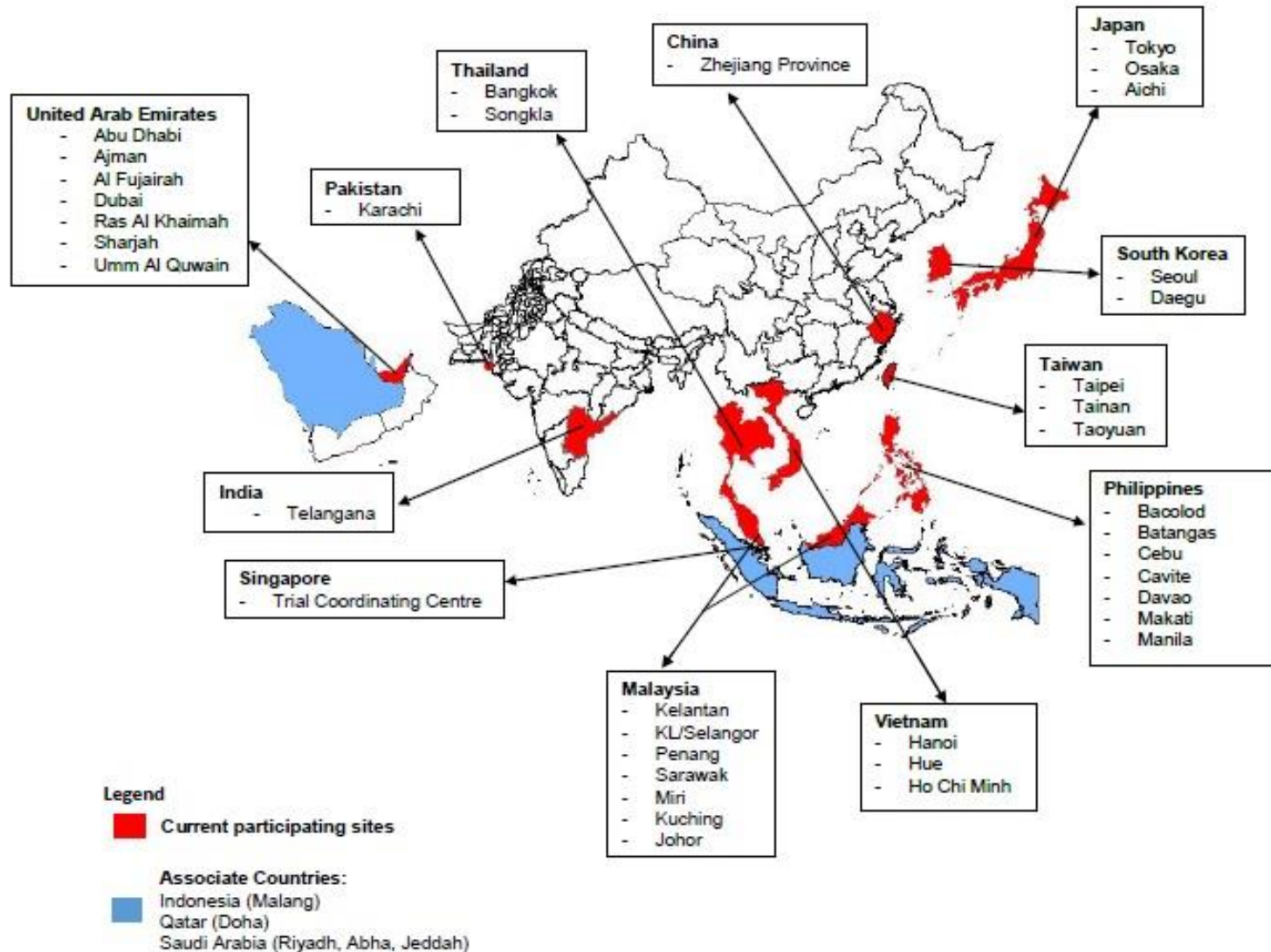
Witnessed, shockable cardiac arrest survival

PAROS 3- Adaptive Stepped Wedge Implementational Trial



SCDF Division	Timeline						
	June 2016	Jan 2017	June 2017	Jan 2018	June 2018	Jan 2019	June 2019
1	A	AB	ABC	ABCD	ABCD	ABCD	ABCD
2	∅	A	AB	ABC	ABCD	ABCD	ABCD
3	∅	∅	A	AB	ABC	ABCD	ABCD
4	∅	∅	∅	A	AB	ABC	ABCD

Pan Asian Resuscitation Outcomes Study



Results - Incidences and Outcomes of OHCA For EMS cases



	Japan (Tokyo, Aichi, Osaka)	Korea (Seoul)	Malaysia (Kuala Lumpur, Kota Bahru, Penang)	Singapore	Thailand (Bangkok, Songkla)	Taiwan (Taipei)	UAE (Dubai)	Overall
Total population coverage	29,582,011	10,249,679	2,760,439	5,076,700	2,576,384	2,650,968	2,003,170	55,899,351
Total number of all cases	51377	7990	389	3023	573	3023	405	66780
Total number of EMS cases	51377	7990	343	2958	299	3023	405	66395
Utstein (Witnessed, VF) (%)								
Total	2199	669	5	321	11	122	46	3373
Incidence rate per 100 000	7	7	0	6	0	5	2	6
EMS ROSC	772 (35.1)	154 (23.4)	0 (0)	36 (11.2)	1 (9.1)	38 (31.1)	6 (13.0)	1007 (29.8)
ED ROSC	Not Available	294 (56.2)	1 (25.0)	98 (30.4)	1 (9.1)	62 (50.8)	9 (19.6)	782/1809 (43.2)
Survived to admission	374/634 (59.0) ¹	290 (43.3)	0 (0)	84 (26.1)	1 (9.1)	23 (18.9)	10 (21.7)	959 (28.4)
Survived to discharged / Alive at 30 th day post arrest	686 (31.2)	206 (30.8)	NIL	37 (11.5)	NIL	23 (18.9)	7 (15.2)	635 (18.8)
Post Arrest CPC 1/2	463 (21.1)	122 (18.2)	NA	23 (7.1)	NA	20 (16.4)	7 (15.2)	636 (18.9)

¹ Data not available from Tokyo and Aichi

Multivariate Analysis of Factors Important for Survival (PAROS)

Variables	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Bystander CPR	1.9 (1.3 - 2.8)	1.1 (0.7 - 1.9)
Bystander AED	5.0 (2.1 - 11.9)	4.0 (1.3 - 11.7)
Response time 8 min or less	1.8 (1.3 - 2.6)	1.3 (0.8 - 2)
Ambulance defibrillation	5.9 (3.9 - 9.0)	1.2 (0.4 - 3.6)
Mechanical CPR by EMS	1.3 (0.7 - 2.5)	1.5 (0.7 - 3.2)
Pre-hospital Advanced Airway	1.0 (0.7 - 1.4)	0.2 (0.1 - 0.3)
Epinephrine	0.5 (0.3 - 0.8)	0.5 (0.3 - 0.9)
Hypothermia	19 (8.5 - 42.4)	27 (10.0 - 72.8)

International Multi-Center
Controlled Trial of Dispatcher-
Assisted Cardio-Pulmonary
Resuscitation Intervention
Package

**Pan-Asian Resuscitation Outcomes
Study Phase 2**

Pan-Asian Resuscitation Outcomes Study Phase 2

Out-of-Hospital Cardiac Arrest Presenting to the EMS Dispatch in the Asia Pacific

Sites Implementing Dispatcher-assisted Cardiopulmonary Resuscitation (Intervention)

Sites Not Implementing Dispatcher-assisted Cardiopulmonary Resuscitation

Sites
Phase 1 'historical' data (2009-2011)/minimum 6 months 'run-in' period before implementation

Sites
Phase 1 'historical' data (2009-2011)/minimum 6 months 'run-in' period before implementation

Phase 1 'historical' data

- Basic Package Implementation**
- Dispatcher-CPR protocol
 - Training program

- Comprehensive Package Implementation**
- Dispatcher-CPR protocol
 - Training program
 - Quality measurement tool
 - Quality Improvement Program
 - Community Education Program

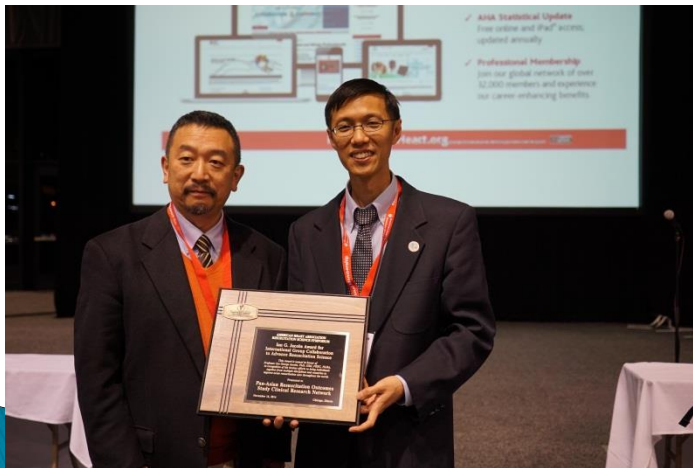
Collection of Out-of-Hospital Cardiac Arrest data only

Collection of Out-of-Hospital Cardiac Arrest and Dispatcher CPR data

AHA ReSS International Group Collaboration to Advance Resuscitation Science Award 2014



Collaborators from Malaysia, Taiwan, Korea, and Japan attending the award ceremony



Research can impact policy!

Pre-hospital Emergency Care

5 Year Plan (2009 – 2014)

Research can impact outcomes!